



Original article

Understanding the Decline in Adolescent Fertility in the United States, 2007–2012

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A B S T R A C T

Purpose: The decline in U.S. adolescent fertility has accelerated since 2007. Modeling fertility change using behavioral data can inform adolescent pregnancy prevention efforts.**Methods:** We used data on sexual activity and contraceptive use from National Surveys of Family Growth for young women 15–19 years of age, and contraceptive failure rates, to estimate a Pregnancy Risk Index (PRI) for the periods 2007, 2009, and 2012. Logistic regression was used to test for change over time in sexual activity, contraceptive use, and PRI. Statistical decomposition was used to calculate attribution of change in the PRI to changes in sexual activity or contraceptive method use.**Results:** Sexual activity in the last 3 months did not change significantly from 2007 to 2012. Pregnancy risk declined among sexually active adolescent women ($p = .046$), with significant increases in the use of any method (78%–86%, $p = .046$) and multiple methods (26%–37%, $p = .046$). Use of highly effective methods increased significantly from 2007 to 2009 (38%–51%, $p = .010$). Overall, the PRI declined at an annual rate of 5.6% ($p = .071$) from 2007 to 2012 and correlated with birth and pregnancy rate declines. Decomposition estimated that this decline was entirely attributable to improvements in contraceptive use.**Conclusions:** Improvements in contraceptive use appear to be the primary proximal determinants of declines in adolescent pregnancy and birth rates in the United States from 2007 to 2012. Efforts to further improve access to and use of contraception among adolescents are necessary to ensure they have the means to prevent pregnancy.© 2016 Society for Adolescent Health and Medicine. Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).IMPLICATIONS AND
CONTRIBUTION

Rapid declines in adolescent pregnancy and birth rates from 2007 to 2012 can be attributed to increases in contraceptive use, including use of any method, multiple methods, and of more effective methods. Based on this and previous research, adolescent fertility declines since 1991 can be primarily attributed to improved contraceptive use.

After substantial declines in the 1990s and early 2000s and a stall from 2005 to 2007, the U.S. adolescent birth rate declined rapidly between 2007 and 2013—dropping 36%, among 15- to 19-year olds [1]. There has also been a 25% decline in the adolescent pregnancy rate over a shorter period, falling from 70 pregnancies per 1,000 women in 2007 to 52 pregnancies per 1,000 women in 2011 [2]. The declines in adolescent pregnancy

and birth rates since 2007 have occurred in all 50 states, across racial and ethnic groups, and among both younger and older teens, although differentials across subgroups and geographic locations remain [2,3]. Increasing use of abortion has not contributed to these declines, and abortion ratios (the ratio of abortions to live births) have declined very slowly over this period [2].

Despite these substantial declines, the United States continues to have adolescent birth and pregnancy rates that are higher than rates of other developed countries. Comparing rates of adolescent pregnancy in 2011, the U.S. rate (52 per 1,000

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females, 15–19) is more than six times as high as Switzerland (8 per 1,000), more than twice as high as France (25 per 1,000) and slightly higher than England and Wales (47 per 1,000) [4]. Most adolescent pregnancies in the United States are unintended [5], and the majority of sexually active adolescent women report that they would be upset if they became pregnant [6].

To date, there has been limited research focused on identifying the causes of these rapid and large declines in the United States since 2007. Adolescent fertility is influenced by both distal and proximate factors. Distal factors may occur at many levels, including individual, household, community, and other structural contexts [7]. Given the broad scope of the declines, research has generally focused on macro-level social and economic factors such as the economy, media, and public policies [8–11]. These distal factors may influence fertility via proximate determinants, including sexual activity and use of contraception; changes in these behaviors and outcomes are national goals for Healthy People 2020 [12].

A focus on adolescent sexual activity and contraceptive use can improve our knowledge of the direct mechanisms driving the observed declines in adolescent pregnancy and childbearing. Understanding these two proximate factors can prime further research to examine distal determinants of adolescent fertility trends and inform policy development and implementation.

We have examined declines in adolescent pregnancy risk across the period from 1991 to 2007 in multiple analyses, using data from the National Survey of Family Growth (NSFG) as well as from high school students in the Youth Risk Behavior Surveillance (YRBS) [13–15]. Using NSFG data for 1995–2002, we found that 86% of the reduction in pregnancy risk among young women aged 15–19 (including both those in and out of school), was due to contraception, with the remainder due to declines in sexual activity (concentrated entirely among younger teens) [14]. Similarly, using YRBS data on high school students—a systematically younger group—we found that the substantial declines in adolescent pregnancy rates in the United States from 1991 to 2007 could be primarily attributed to improved contraceptive use [15].

A previous analysis estimated borderline increases in the pregnancy risk between 2003 and 2007 that paralleled a small increase in the actual adolescent birth and pregnancy rates from 2005 to 2007 [15]. This study and others validate our approach to measuring pregnancy risk, which accounts for sexual activity, contraceptive use, and contraceptive failure [16,17].

Building directly on these previous studies, this article uses NSFG data to examine how changes in adolescent sexual activity and contraceptive use influence adolescent fertility risk in the United States from 2007 to 2013. This analysis utilizes newly estimated method-specific contraceptive failure rates for the United States [18]. We estimate trends in sexual activity and contraceptive use patterns and use statistical decomposition to attribute declines in pregnancy risk to these two behavioral components.

Methods

Data

The NSFG is a periodic national probability household survey of women and men aged 15–44 years in the United States [19]. The NSFG used a multistage, stratified-clustered sampling frame; interviews were conducted continuously from June 2006 to

December 2010 and again from June 2011 to June 2013. Sampling weights provided by the National Center for Health Statistics allow division of the data into three nationally representative and nonoverlapping periods: June 2006–June 2008, July 2008–December 2010, and June 2011–June 2013, which we refer to as 2007, 2009, and 2012, respectively. Our analyses were limited to women aged 15–19 at the time of the interview (2007 $n = 1,085$, 2009 $n = 1,199$, and 2012 $n = 1,037$). Methods of data collection and dissemination of the public use data set were reviewed by National Center for Health Statistics' institutional review board protections of human subjects.

Measures

Following the methodology we developed and refined in prior work [13–16], we calculated the Pregnancy Risk Index (PRI) for each period estimating the annual risk of becoming pregnant among adolescent women based upon recent sexual activity (vaginal-penile sex in the last 3 months), contraceptive method(s) used at last sexual intercourse, and method-specific contraceptive failure rates (CFRs); nonuse of contraception was assigned a specific risk of pregnancy as well. Thus, the PRI score represents each woman's risk of pregnancy in 1 year, given her sexual activity and contraceptive use. The overall PRI summarizes, at the population-level, the risk of pregnancy among all adolescents, incorporating information about both the level of recent sexual activity and the level of contraceptive risk.

For each individual i , we calculated a PRI score with the following formula:

$$PRI_i = \text{Sexually Active}_i \times \text{CFR of method(s) used at last intercourse}_i$$

The mean of these individual scores is the overall PRI of the entire population. As indicated by the formula, the PRI score for a woman who was not sexually active in the past 3 months (or had never had sexual intercourse) was set to zero, as she did not face a current risk of pregnancy. The PRI for each sexually active woman was estimated as the CFR of the methods used at last intercourse. We used new typical-use 1-year CFRs estimated from the 2006 to 2010 NSFG pregnancy and contraceptive calendars and adjusted for abortion underreporting [18]. A “typical-use” CFR is the number of pregnancies occurring among 100 women using a specific contraceptive method over a 12-month period; typical use refers to the way a method is actually used by women and their partners, including inconsistent or incorrect use [20]. Recent research has found significant variation in CFRs by race/ethnicity but not age [18]. Thus, for the most common methods (pill, patch, condom, and withdrawal), we used race/ethnicity-specific CFRs for 15- to 44-year olds (Failure rates stratified by race/ethnicity are available for women identified as Hispanic, non-Hispanic white, and non-Hispanic black. For the 6% of respondents identified as “other”, we applied the CFR for non-Hispanic white women.). For less common methods, only overall CFRs were available. To represent the reduced pregnancy risk associated with the use of two methods at most recent intercourse, we followed the practice of earlier research and multiplied the method-specific CFRs [15,16]. (Although women could report simultaneous use of up to four contraceptive methods, we limited our failure rate calculations to the two most effective methods.)

Sexually active women using no method at last intercourse were assigned a PRI score of 85, based on widely accepted

Table 1

Percentage of young women aged 15–19 by sexual activity and NSFG survey year, 2007–2012

	2007 (N = 1,085)		Survey year 2009 (N = 1,199)		2012 (N = 1,037)		2007 versus 2009	2009 versus 2012	2007 versus 2012
	%	95% CI	%	95% CI	%	95% CI	<i>p</i> value	<i>p</i> value	<i>p</i> value
Measures of sexual activity									
Sexually active in last 3 months	31	27.2–35.1	33	29.6–37.2	30	25.3–35.1	.399	.279	.740
Sexually active in last 12 months	39	34.3–44.3	42	37.8–46.3	40	34.4–45.7	.700	.140	.330
Sexually active in the last 4 weeks	25	21.9–28.8	28	24.6–31.4	25	20.1–29.8	.290	.280	.852
Ever had sex	43	37.9–47.9	45	41.1–49.7	45	39.3–50.4	.460	.871	.603

All measures refer to vaginal–penile intercourse.

CI = confidence interval.

estimates of the risk of pregnancy over a 12-month period [21]. Finally, following the approach of earlier research, women who were pregnant at the time of interview ($n = 30$ cases in 2007, 28 in 2009, and 27 in 2011) were assigned the contraceptive method that they reported using at the time they became pregnant [14]; (90.5% reported using no method at the time they got pregnant).

Analysis

For each of the three time periods (2007, 2009, and 2012), we estimated the percentages of sexually active female adolescents (sex in the last 3 months), the contraceptive methods used at most recent intercourse (or when pregnancy occurred), and the number of methods used, testing for significant changes over time between adjacent periods (2007 vs. 2009 and 2009 vs. 2012) and across the whole time period (2007 vs. 2012) using logistic regression. As a sensitivity analysis, we also examined changes over time in alternate measures of adolescent sexual activity (sex in the last 12 months, sex in the last 4 weeks, and ever had vaginal intercourse). Contraceptive method use was estimated for individual methods, as well as the overall use of highly effective methods (including intrauterine device, implant, injectable, pill, patch, and ring).

Next, we estimated the mean PRI among sexually active adolescents, and all adolescent women, for each period. We used paired t tests for the difference in means to test for significant changes over time. All analyses accounted for the complex survey design of the NSFG data using the `svy` commands in Stata 14 [22].

To compare the PRI estimated from the NSFG to actual pregnancy rates and birth rates for 15- to 19-year olds, we calculated Pearson correlation coefficients and compared the annualized rate of change in each measure. Pregnancy rates were available through 2011, while we examined birth rates through 2013 to align with the behavioral data from the NSFG (sexual and contraceptive behaviors in 2012 would result in births in 2013). Birth rates are a good proxy for pregnancy rates in assessing trends over time, as the ratio of abortions to live births has changed little from year to year among adolescents since 2007 [2].

Finally, to assess the extent to which the decline in the PRI from 2007 to 2012 was due to changes in sexual activity or changes in contraceptive use, we statistically decomposed the PRI into these two component parts. In the standard demographic decomposition formula described by Das Gupta [23] for decomposing change over two time periods, the first component of the PRI (sexual activity, in this case) is held constant in order to calculate a standardized rate: the amount we would expect the PRI to change if only the second component

(contraceptive use) had changed. To extend this methodology to address change over three time periods, we instead calculated standardized changes in the rate between the first and second periods as well as between the first and third periods; we then averaged the two to arrive at the standardized change in the rate over the full period 2007–2012. This standardized change is divided by the observed change in the rate from 2007 to 2012 to give us the estimated proportion due to contraceptive use over the three time periods; the expected proportion due to sexual activity is calculated as its complement.

Results

Sexual activity in the last 3 months among all females ages 15–19 did not change significantly between 2007, 2009, and 2012 (31% 2007, 33% 2009, and 30% 2012), Table 1. Similarly, none of the alternate measures of sexual activity (sex in the last 12 months, sex in the last 4 weeks, and ever had vaginal intercourse) changed significantly between periods either.

Overall, contraceptive use patterns indicate increases in the use of methods by adolescent females during the examined period (Table 2). There was a statistically significant decline from 2007 to 2012 in the share of adolescents reporting no method use at last sex (22%–14%, $p = .046$). Conversely, the share of teens reporting one or more methods used at last sex increased significantly from 2007 to 2012, rising from 78% to 86%. There also was a statistically significant increase in the share of adolescent females reporting multiple method use (two or more methods) at last sex, increasing from 26% in 2007 to 37% in 2012 ($p = .046$); pill and condom were the most common combination across the period. Few young women reported use of three or more contraceptive methods at last sex. Overall, the use of all highly effective methods (IUD, implant, injectable, pill, patch, and ring) increased from 2007 to 2009 (from 38% to 51%, $p = .01$) but then did not change significantly from 2009 to 2012.

Despite these increases in use of any method and multiple methods, we found few significant increases in use of any specific methods at last intercourse. Use of IUD or implant had a marginally significant increase from 2007 to 2009 (from 1% to 4%, $p = .072$) but was unchanged in the later period, while use of injectables did not change significantly over time. From 2007 to 2012, there was a marginally significant increase in use of the pill (26%–35%, $p = .068$) but a significant decline in use of the patch or ring (5%–1%, $p = .007$). There were also nonsignificant increases in condom use (49%–55%) and withdrawal (15%–20), while use of the rhythm method did not change and remained at or less than 2%.

Selected contraceptive method use among adolescent women (15–19 years) who have engaged in recent^a sexual intercourse by NSFG survey year, 2007–2012

[illegible]

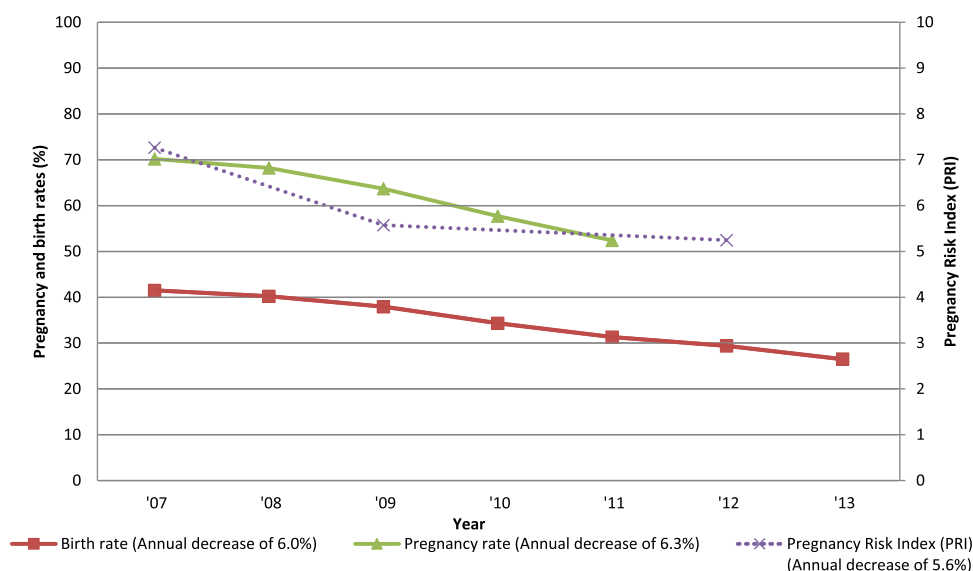


Figure 1. Birth rate, pregnancy rate, and pregnancy risk among women aged 15–19 years, 2007–2013.

high school students from 2013 to 2015—after a long plateau from 2001 to 2013 [24]. At this point, it is unclear whether these new data represent a new trend or are the result of other factors.

The PRI methodology, which creates a composite measure, identified reductions in overall risk not apparent in the individual contraceptive method use measures. Although overall contraceptive use increased, changes over time in specific methods generally were not statistically significant at conventional levels. However, with less than one-third of adolescent women sexually active, our statistical testing for changes in contraceptive use was underpowered. Although we found small (and not statistically significant) changes in some contraceptive methods, it was in combination that, these changes resulted in significant reductions in the PRI.

Although some studies have descriptively linked increased access to LARC (long-acting reversible contraceptive) methods to localized declines in adolescent birth rates [25,26], our analysis indicates that LARC use has played a modest role at the national-level through 2012. While the share of adolescents using LARC at last sex did not change significantly during the period under study, this may change moving forward with newer clinical guidelines supporting LARC methods as first-line contraceptive choices for adolescents [27,28]. Recent data collected from high school students in the YRBS survey documents an increase in IUD and implant use from 2013 to 2015 for female students [24]. Given its relatively low failure rates, even with typical use, future increases in LARC use would reduce pregnancy risk. But any efforts to promote LARC use should be guided by individuals' method preferences and reproductive autonomy, recognizing that contraception is a personal decision and not “one size fits all” [29].

These analyses rely on new typical-use CFRs estimated from the 2006–2010 NSFG [18]. These new failure rates have decreased as compared to estimates derived from earlier rounds of the NSFG, indicating improvements in how couples use contraception. (These improvements contrast with little change in CFRs between 1988 and 2002.) [30–32] Estimates for all

methods from the 2006–2010 survey are more than one-third lower than those from the 1995 survey. Studies that do not incorporate these improvements in CFRs may miss an important influence on adolescent pregnancy and birth rates [8,33].

The recent declines in adolescent pregnancy and birth rates in the United States have not occurred in isolation but are part of nearly universal reductions in adolescent fertility during the second half of the 20th century. Since the 1950s in both the United States and Western Europe, declining adolescent fertility has been influenced by widespread social forces such as rising educational opportunities for young women, the invention of modern methods of contraception, rising age at marriage, and legalization of abortion [34]. Prior research found that much of the difference in adolescent pregnancy rates between the United States and European countries resulted from lower rates of contraceptive use among U.S. adolescents [35]; the increasing rates documented here may reduce these differences.

Limitations

This analysis had several limitations. Although the overall NSFG sample size is adequate, small sample sizes in key subgroups, particularly sexually active adolescents, constrained our ability to examine differential patterns by racial/ethnic or age groups within the adolescent population. Estimates of method-specific contraceptive use among sexually active adolescents were underpowered, reducing the likelihood of estimating statistically significant changes.

We applied CFRs estimated from the 2006–2010 NSFG; any potential changes within this period, or since 2010, cannot be identified. We also assumed that there was no change in adolescents' biological fecundity during the relatively short study period. The analysis relies on self-reports which may reflect social desirability bias or other reporting errors. Our analysis did not consider changes in the composition of which adolescents use which contraceptive methods, and further attention should

be given to heterogeneity among adolescents by their method of contraception.

We recognize that by focusing on changes in the proximate determinants of adolescent pregnancy—sexual activity and contraceptive use—this analysis does not measure how upstream social or ecological influences impact these behaviors. Future research should continue to investigate the distal influences of the recent declines in adolescent pregnancy. The findings of this analysis also argue for a focus on mechanisms that influence contraceptive use patterns instead of influences on sexual activity, which has contributed little to the ongoing declines in adolescent pregnancy risk.

Public health implications

The rapid declines in adolescent pregnancy and births from 2007 to 2012 occurred despite stagnant rates of sexual activity. Instead, we find that the contraceptive behaviors of sexually active adolescents have driven the recent shifts in fertility outcomes. The increases in overall contraceptive use at last sex from 2007 to 2012 are part of a longer trend. Between 1995 and 2012, any method use at last sex among adolescent women increased from 66% to 86%, while use of multiple methods increased from 11% to 37% [14]. Taken together, evidence from this study and our previous studies indicates that the substantial long-term decline of 57% in adolescent birth rates from 1991 to 2013 [1] can be primarily attributed to increases in overall contraceptive use. With the risk of pregnancy associated with no method use at 85%, adolescents' uptake of any method, regardless of its failure rate, markedly reduces this risk. Policy discussions should focus on supporting adolescent contraceptive use generally, including access to the full range of methods.

Public policy and programs can play a critical role in supporting adolescent contraceptive use. Since contraceptive use is the critical driver of adolescent fertility, it is important to ensure adolescents' access to comprehensive sexuality education that provides medically accurate information about contraception. A recent meta-analysis of comprehensive sexuality education and abstinence-only programs evaluation data indicates that comprehensive sexuality education can increase condom and contraceptive use; however, abstinence-only programs have not demonstrated effectiveness in changing adolescent sexual behavior or in reducing teen pregnancy or sexually transmitted infections [36]. Despite recent declines in adolescent pregnancy, the percentage of adolescents who report receiving formal instruction about birth control has declined, while the share receiving only abstinence instruction has increased [37]. The increased availability of the Internet to adolescents and the anonymity it provides for searching sensitive topics, offers new opportunities to meet the sexual health needs of adolescents [38]. Further research should examine adolescents' use of online sexual and reproductive health information online, as well as the quality of this information.

The increase in adolescent contraceptive use may reflect recent efforts to increase adolescents' access to reproductive health services, including expanding private and public insurance coverage through the Affordable Care Act and changing clinical guidelines [27,28,39]. Despite insurance expansion, publicly funded family planning centers remain an important source of contraceptive and reproductive health care, serving more than one million adolescents in 2013 [40]. Continued support of funding mechanisms that provide adolescents with

confidential and comprehensive sexual and reproductive health care are necessary to maintain and expand the contraceptive use patterns observed in this study and to ensure access to supportive and essential adolescent health services.

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